

U.S. Patent Application Serial No. 10/577,322
Amendment filed February 11, 2009
Reply to OA dated September 5, 2008

AMENDMENTS TO THE SPECIFICATION:

Amend the paragraph beginning at page 2, line 34, as follows:

3. An electroluminescent material including an oxide having a perovskite-type crystal structure represented by General Formula $RZ_2Cu_3O_6$, wherein R represents at least one rare-earth element, and Z represents at least one ~~alkali-earth~~ alkaline earth metal.

Amend the paragraph beginning at page 3, line 3, as follows:

4. An electroluminescent material according to any one of Items 1 to 3, wherein the oxide further includes at least one dopant selected from the group consisting of ~~alkali-earth~~ alkaline earth metals, Mg, alkali metals, and transition metals.

Amend the paragraph beginning at page 3, line 11, as follows:

6. An electroluminescent material according to Item 3 or 4, wherein the ~~alkali-earth~~ alkaline earth metal is at least one member selected from the group consisting of Ca, Sr, and Ba.

Amend the paragraph beginning at page 3, line 22, as follows:

10. An electroluminescent material according to Item 4, wherein the proportion of the ~~alkali-earth~~ alkaline earth metal dopant contained in the oxide (mole % of ~~alkali-earth~~ alkaline earth metal(s) added as dopant(s) relative to M or Cu) is 0.001 to 10 %.

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Amend the paragraph beginning at page 5, line 18, as follows:

(3) an electroluminescent material including an oxide having a perovskite-type crystal structure represented by General Formula $RZ_2Cu_3O_6$, wherein R is at least one rare-earth element, and Z is at least one ~~alkali-earth~~ alkaline earth metal.

Amend the paragraph beginning at page 5, line 25, as follows:

Examples of usable ~~alkali-earth~~ alkaline earth metals Z include Ca, Sr, Ba, etc. Among these, Ca and Sr are particularly preferable.

Amend the paragraph beginning at page 5, line 27, as follows:

The oxide, which is a constituent component of the electroluminescent material of the present invention, may further include at least one member selected from the group consisting of ~~alkali-earth~~ alkaline earth metals, Mg, alkali metals, and transition metals as an added impurity (dopant). Hereunder, added impurity means "dopant". By doping with an impurity, oxygen defects that serve as the luminescence centers in the oxide are stabilized.

Amend the paragraph beginning at page 6, line 5, as follows:

The ~~alkali-earth~~ alkaline earth metals Z exemplified above can also be used as ~~alkali-earth~~ alkaline earth metal dopants.

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Amend the paragraph beginning at page 6, line 16, as follows:

The content of ~~alkali-earth~~ alkaline earth metal dopant in the oxide (i.e., mole % of ~~alkali-earth~~ alkaline earth metal(s) added as dopant(s) relative to M or Cu) is generally 0.001 to 10%, preferably 0.005 to 5%, and more preferably about 0.01% to about 2%.

Amend the paragraph beginning at page 16, line 25, as follows:

The perovskite oxide used in the present invention is a material having a so-called strongly correlated electron system, and the electrons and positive holes therein tend to have a great mobility, do not readily annihilate, and can move a long distance. Such a perovskite oxide tends to have extremely great oscillator strength in the visible light range, and the electrical conductivity thereof can be enhanced by doping with a very small amount of dopant. The perovskite oxide achieves very strong luminescence (fluorescence) when irradiated with ultraviolet-rays. Such luminescence is caused by color centers due to oxygen defects in the crystal lattice of the perovskite oxide rather than interband transitions occurring at a band-edge of the perovskite oxide. Such oxygen defects occur in a perovskite oxide of the present invention synthesized by the FZ method, etc., while irradiating ultraviolet rays under a reducing atmosphere. When such a perovskite oxide is irradiated with ultraviolet rays, highly intensive fluorescence is observed due to electronic excitation from the color center formed by oxygen defects to a conductive band. The wavelength of the fluorescence (i.e., color) is peculiar to the type of the perovskite oxide and can be altered by appropriately selecting the rare-earth element. If at least one metal selected from the group consisting of ~~alkali-earth~~ alkaline

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earth metals, Mg, alkali metals, and transition metals is doped in the perovskite oxide while synthesizing it in such an amount that the crystal lattice is not fractured, remarkably intense fluorescence can be generated compared to an undoped perovskite oxide. The fluorescence lifetime is as short as about 15 ns, and the fluorescence quantum yield is as high as 45%. It is presumed that this is because the above-mentioned dopants stabilize the oxygen defects that constitute the color centers. When the size of the dopant is not very large, the emission wavelength is not strongly affected by the type of dopant. However, when the dopant is relatively large, distortion occurs in the crystal lattice of the perovskite oxide, and the emission wavelength thereof is shifted. It is therefore also possible to control the emission wavelength using such an effect.